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GB 1581125 A US 3592148 A US 1603097 A

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(54) Active protective element

(57) Apparatus for protecting a moving or stationary object against an approaching projectile 14 comprises at least one plate or tube 1, 2, 3 having receptive contact strips 6, 7, 8, 9 coupled to a computer which, upon the projectile 14 striking the contact strips, initiates igniting devices 12 to provide a counter-action in accordance with a predetermined programme. The elements 1, 2, 3 are arranged in grooves 13 in a base plate 4, the plate being supported by a foot 5 accommodated in a shoe 10 fixed to the object to be protected. The counter-action may include movement of elements 1, 2, 3 or activation of cutting charges 11, explosive for which is disposed beneath foot 5, within grooves 13 and beneath the plates of charges 11.

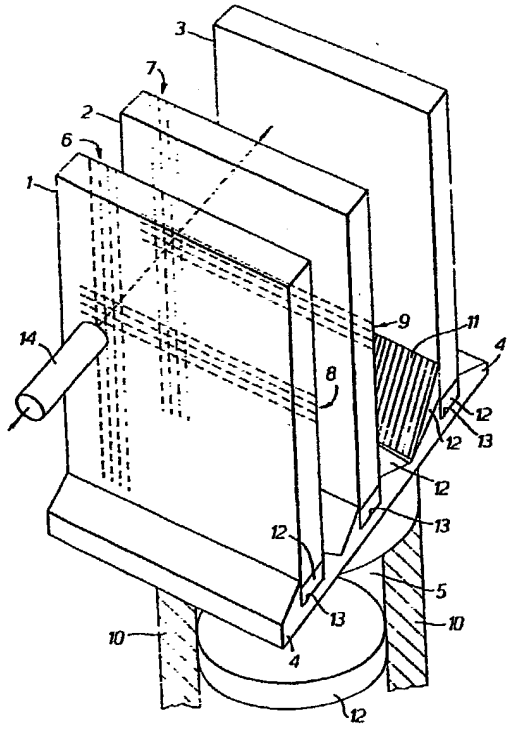

FIG. 1.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

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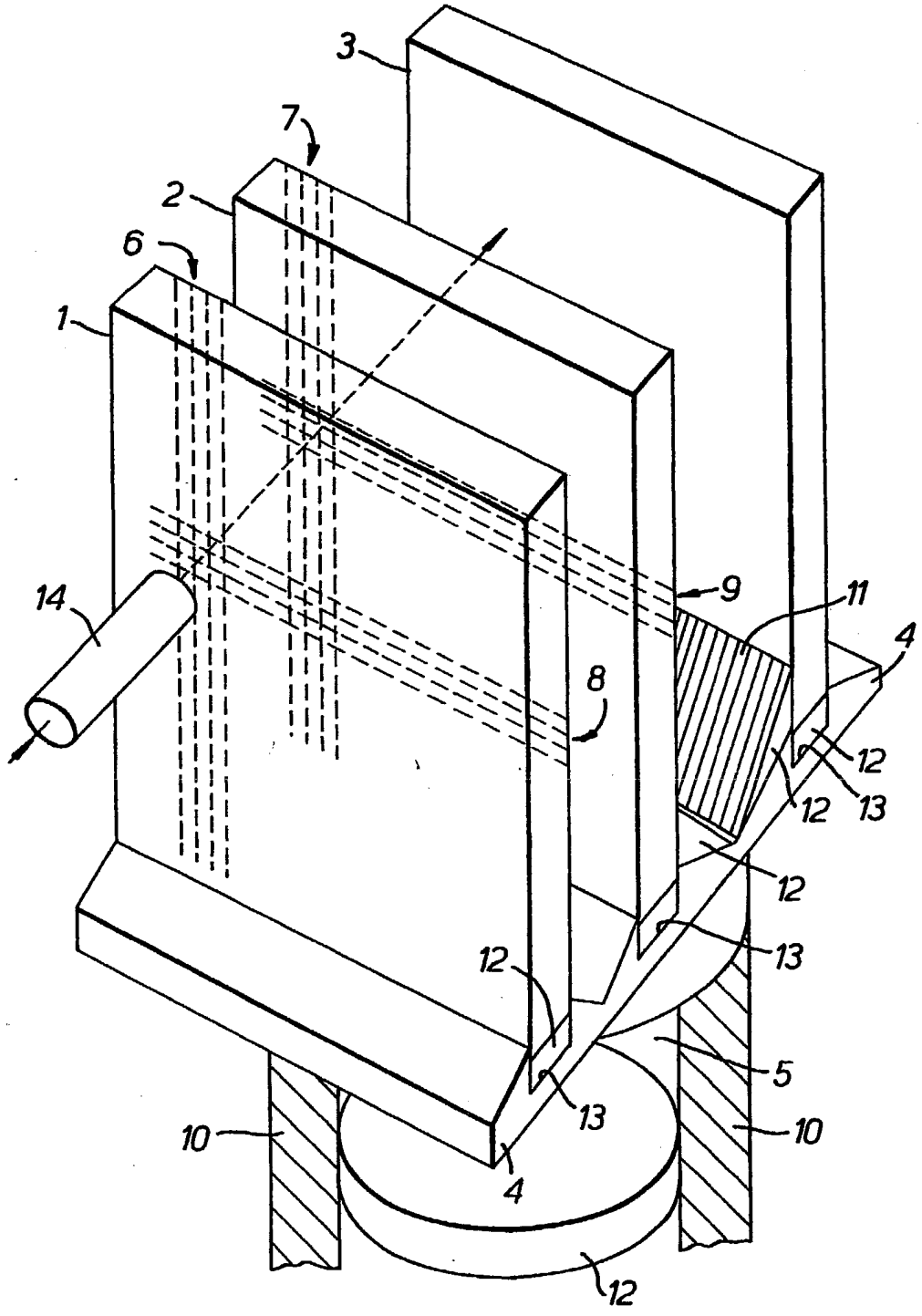

FIG. 1.

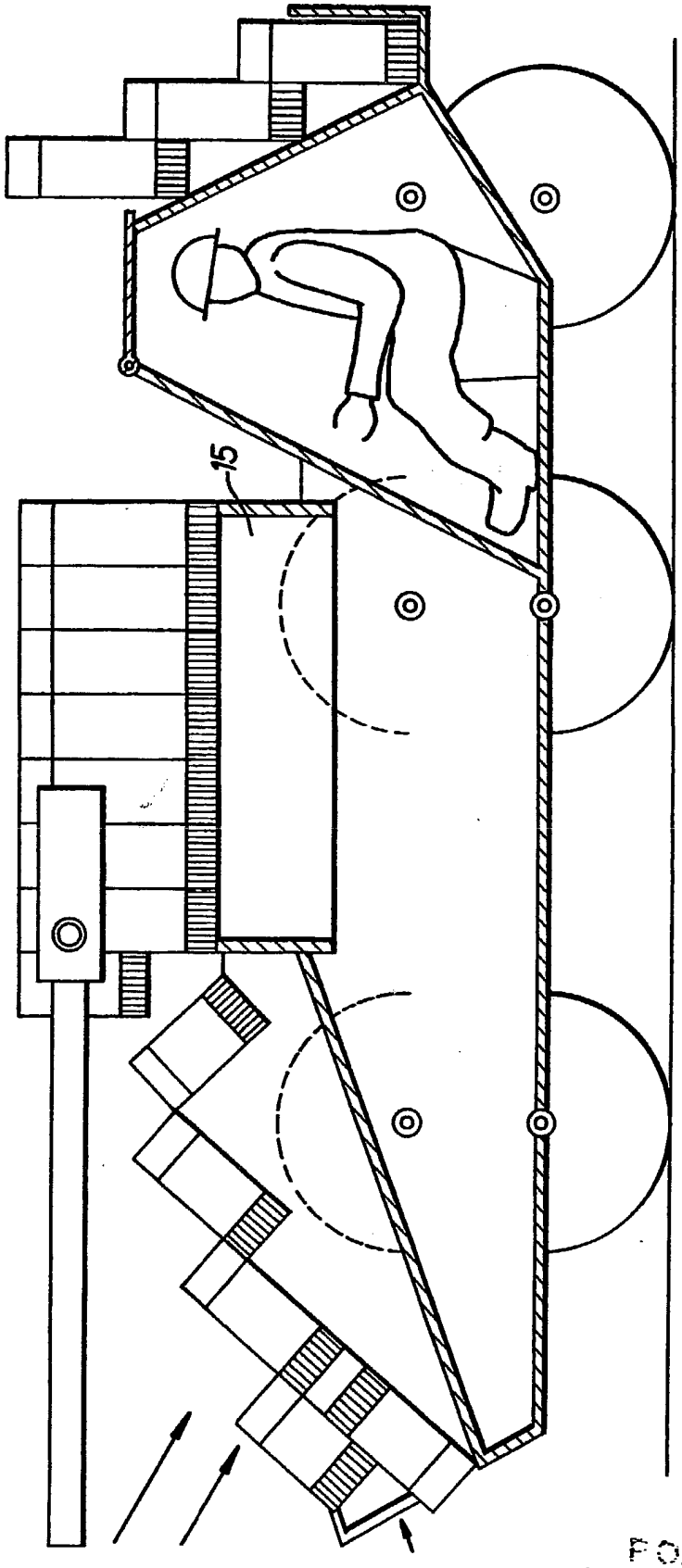

FIG. 2.

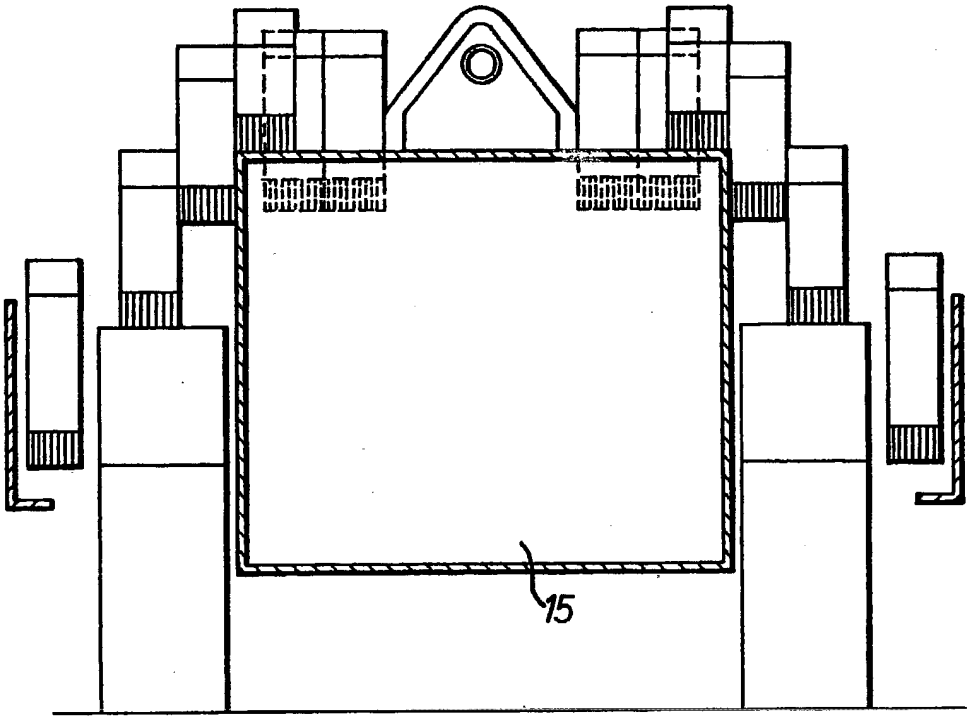

FIG. 3.

TITLE OF THE INVENTION

"An active protective element for a military object with the ability to react selectively to the effect of bombardment"

PRIOR ART

The effect of bombardment on armoured equipment or objects of military forces is largely attributable - in simplified terms - to three types of weapon, namely projectiles, projectile cores and hollow explosive charges. The sequence of this list is also indicative in approximate terms of the nature of the effect and its increasing effectiveness. If the effect is to be intercepted for example by a rigid armour plate, a large mass of armour material is required in the direction of the projectile trajectory in order to afford adequate protection. Accordingly, the protection of cross-country vehicles has long required a weight of around 25 tonnes of armour steel where, in addition to obtaining effective all-round armour plating, it is desired optimally to protect at least one front shield. However, since on the other hand mobility in the field of battle has to be guaranteed according to particular requirements, the above-mentioned weight is in effect the permitted limit.

Several proposals for reducing the weight of protection are based, as is the present invention, on the concept of "active armouring". Active armouring is generally designed in such a way that it is stimulated by the effect of bombardment into a highly energetic counter action. The stimulation detonates an explosive which moves a mass against the attack. One hitherto known active armour protection is immediately brought to counteraction by the projectile. According to one proposal, this may even be done for example by photocell sensors which determine the point of impact of

the projectile and use the hollow charge effect for counteraction. The disadvantages of proposals such as these which seek to use sensors lie on the one hand in the difficulties encountered by the design engineer in having to integrate the sensors into the object to be protected. According to existing proposals, the sensitive sensors and activators are supposed to be positioned in the area around the object to be protected in order to obtain adequate protection. On the other hand, the proposals do not place any value on selection according to the type of projectile. For example, it is not possible to distinguish between projectiles of high and low kinetic energy, which is particularly important in the case of KE-projectiles (kinetic-energy projectiles). The currently favoured installation for counteractions which uses the effect of self ignition (at the test stage) is unable to select and only acts significantly against the effect of the hollow charge. All similar proposals have an inadequate effect against KE-projectiles.

DESCRIPTION OF THE INVENTION

The present invention relates to a self-contained, independently acting, space-filling element which, in contrast to existing proposals on the subject of active armour protection, analyses the nature of the effect of the attack at an early stage and, depending on the intensity of the attack, combats the projectile with various means or may even offer no resistance whatever to the projectile when the effect does not exceed a predetermined threshold.

The element is used in such a way that the entire surface to be armoured is composed of the element in an (optionally) close arrangement so that each hit has to stimulate an element. The element then counteracts by accelerating a predetermined mass into the path of attack by means of explosive and imparting

a lateral acceleration to the projectile (at a large angle to the direction of attack). In addition, one or more hollow charges arranged in the manner of a cutting charge at a short distance from the projectile may be ignited laterally towards the path of attack at a time calculated in such a way that the projectile is hit. This second counteraction takes place at a speed approaching that of a stream of attacking hollow charges.

By virtue of its configuration, the fact that its plate surfaces may optionally be equipped with contact strips arranged crosswise one above the other and the optional presence of an on-board electronic computer, the element is capable of analysing the important properties of an attacking projectile. Unless a counteraction is initiated in known manner by direct effect, the computer instructs the element to counteract into the path of attack of the projectile after having determined the probable effect of the attack of the projectile. The properties open to analysis are the diameter of the projectile, its velocity and its direction. Providing the protective element is standardised, a direct assessment of the energy of the projectile may also be programmed into the computer.

The element determines these data while the projectile strikes and penetrates. Before it has penetrated through all the plates of the element, the computer has decided on the counteraction. The decision may read as follows: "no counteraction", "move plates" and/or "cutting charges", "move complete element" and other combinations. The time required for calculation and counteraction amounts to between 10^{-4} and 10^{-5} seconds. Given the most stringent requirements, the ignition time error should amount to at most $\pm 2 \cdot 10^{-6}$ sec.

The invention relates in particular to the construction of the element. As can be seen from the accompany drawing, which illustrates one simple example, it consists of a number of plates (flat or curved) arranged one behind the other (1;2;3). The drawing shows an element of three plates vertically arranged parallel to one another on a base plate (4) which is supported by the foot (5). In the example shown in the drawing, the first two plates are provided on their rearward surface with contact strips (6;7;8) which, in cases where the protective element is maximally equipped, cover the entire surface crossing and closely adjacent one another. The effect of these contact strips is that the penetrating projectile transmits electrical signals to the electronic computer. When the computer is programmed to certain types of projectile, the signals initiate the corresponding calculation. The decision on the counteraction is the outcome of this calculation.

The plates (1;2;3) are situated in the grooves and guides (13) of the base plate (4) whilst the foot (5) is accommodated in the shoe (10) which, in general, is fixedly connected to the object to be protected. Explosive is arranged together with an ignition device (12) beneath the foot (5), beneath the plates in the grooves of the base plate and beneath the roof-like plates of the cutting charges (11). Instead of using plates, a similar effect may be obtained with round or angular tubes. Like the base plate and its foot, they may be made of a variety of materials, depending on requirements, particularly in regard to weight, for example of steel, lightweight metal, plastics, ceramics, foams. Materials selected for the purpose of guiding the plates (or tubes) and also quite generally for supporting the counteraction are accommodated in the spaces in between. So far as the empty

space of the cutting charges is concerned, these materials are advantageously liquids, foams or lightweight loose materials. The effect of the plate mass of the cutting charge may thus be advantageously influenced.

The counteraction is initiated by the computer instructing the ignition devices to detonate. In this way, the mass of the plates is moved as required, the plate mass of the cutting charges being moved at particularly high speed. The computer and/or its programmes are replaceable.

All the elements may be connected to other predetermined receivers, i.e. even to other elements. In this way, the projectile data determined are brought to the knowledge of the tactical command. In addition, the data are a direct signal for an automatic reaction between object and weapons and also for other protective measures.

However, the computer may even be left out in cases where it is desired to respond to only a few cases of the effect of the attack. If for example it is only desired to distinguish between minimal (up to about 5 cm calibre) and maximal projectile (maximal hollow charge and/or large KE-projectile) and if the direction of the projectile is of no interest, it is sufficient to provide the element with one or more contact surfaces (instead of the strips), so that, up to the lower limit, only part of the element and, beyond it, the entire element reacts, optionally several elements in succession.

In the context of the invention, the word "contact strip" refers primarily to the contact of the projectile with strips which have or are capable of initiating an electrical or electromagnetic signal function. The strips may form - in the communications context - a contact network together with a coupling multiple. The signals may:

- release a mechanism (without computing operations),
- initiate an energy variance (without computing operations),
- bring two conductors into contact by altering the original form,
- disturb a double conductor in the built-up state (e.g. a general four-pole),
- alter the capacitance of a capacitor,
- alter an existing inductance (the strips may be inductively coupled conductors),
- alter the resistance of a ring main,
- alter an electromagnetic field (in the non-conductor).

THE ASPECTS OF NOVELTY

The protective element is entirely new and the effect of the element is also new in several respects:

-The attacking projectile is analysed on impact for its possible effect, the result of analysis being available both for the immediate counteraction and also for further receivers.

-The counteraction may be selected in terms of its intensity so that it combats for example a low-effect projectile in such a way that the element remains intact for further counteractions.

-In some cases, one element may not be enough to withstand heavy attack (KE-ammunition, multiple hollow charges and the like), depending on the configuration and equipment of the element. In that case, several elements have to be set up in the direction of the attack so that they adequately complement one another. The computer in the first element selects the cooperating element according to the direction because it is electrically connected thereto.

-Information on the possible enemy comes from a central computer, optionally in the object to be protected. The enemy

experiences the counteraction in some cases in the same second, so that he is made aware of the fact that he is seriously endangering himself by his aggression.

-The protective element may be designed and arranged in such a way that it covers any direction of the projectile with equal effect. For example, it may even be provided in the upper closure, cover, plates with contact strips which initiate the described counteraction to an attack from above. In this way, the element moves upwards away from the object to be protected and not sideways to endanger the vicinity.

-Like a counter projectile, the element is independent and may be replaced at any point of the armour. It is of variable configuration so that it may be adapted to meet any design requirements.

CLAIM

An arrangement for protecting moving or stationary objects such as, for example, tanks, ships, bunkers or the like against approaching projectiles (14), such as bullets, rockets, bombs and the like (as an example the drawing in which the side panels and top panels enclosing the arrangement have been left out), characterised in that the object to be protected is preferably surrounded on all sides by protective elements which comprise at least one, but preferably two or more flat or curved plates arranged behind or above one another, telescoped tubes of different diameter or the like (1,2,3) covered by contact strips (6, 7,8,9) arranged in at least one plane or surface, but preferably arranged crossing one another in various planes or surfaces, the plates or tubes being arranged in grooves or guides (13) of a base plate (4) which is guided by way of a foot (5) in a holder (10) optionally spatially connected to the object to be protected, and in that arranged beneath the plates or tubes between them and the guides in the base plate and/or beneath the foot of the base plate between the foot and the holder and/or adjacent or between the plates are explosive charges (12) comprising ignition mechanisms which are kept as required in electrically conductive connection by a computer which in turn is electrically connected to the contact strips so that, in the event of variation or interruption of one or more of the contact strips, either the charges are directly ignited or the computer receives electrical signals which are processed by the computer according to program and lead in the form of electrical signals to the release or ignition of one or more of the explosive charges and/or are relayed to another predetermined receiver.

Amendments to the claims have been filed as follows

Claims:

1. An apparatus for protecting a moving or stationary object against an approaching projectile, the apparatus comprising a projectile intercepting member having a receptor coupled to a computer controlling ignition of an explosive charge in accordance with a predetermined programme to cause means comprised by the apparatus to counteract the impact of the projectile, the receptor being comprised of contact strips arranged on a surface of said projectile intercepting member, said contact strips having or being capable of initiating an electrical or electromagnetic signal function supplied to the computer to be utilised in said computations.

2. Apparatus as claimed in claim 1, in which said projectile intercepting member is in the form of a flat plate.

3. Apparatus as claimed in claim 1, in which said projectile intercepting member is in the form of a curved plate.

4. Apparatus as claimed in claim 1, in which said projectile intercepting member is in the form of a cylindrical tube.

5. Apparatus as claimed in claim 1, in which said projectile intercepting member is in the form of an angular tube.

6. Apparatus as claimed in claim 4 or 5, in which a plurality of said projectile intercepting members are provided, each member being telescoped one within the other.

7. Apparatus as claimed in any one of the preceding claims, in which a plurality of said projectile intercepting members are provided, the members being arranged one behind the other.

8. Apparatus as claimed in any one of the preceding claims, wherein said contact strips are

arranged in a cross-wise configuration on a surface of said projectile intercepting member.

9. Apparatus as claimed in any one of the preceding claims, in which the or each projectile intercepting member is arranged in a respective groove or guide in a base plate.

10. Apparatus as claimed in claim 9, wherein said base plate is mounted on a foot which is connected to a said object.

11. Apparatus as claimed in claim 10, in which said explosive charge is arranged beneath said foot.

12. Apparatus as claimed in claim 10 or 11, wherein said explosive charge is in the form of a cutting charge placed adjacent said groove or guide.

13. Apparatus as claimed in claim 9, 10, 11 or 12, in which said explsive charge is placed in said groove or guide.

14. Apparatus as claimed in any one of the preceding claims and including an ignition device for said explosive charge.

15. Apparatus as claimed in any one of the preceding claims, in which said computer is provided in a said object.

16. An apparatus for protecting a moving or stationary object against an approaching projectile, substantially as hereinbefore described with reference to Figure 1 or Figures 2 and 3 of the accompanying drawings.

17. A vehicle incorporating an apparatus as claimed in any one of the preceding claims.

18. A vehicle as claimed in claim 17, in which

a plurality of sets of said apparatus are provided to protect the fore and aft and the lateral sides of the vehicle.

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